Research Project

Real-Time and Predicted Line Rating of a Transmission Line

August 2012

Project Classification

ATC initiated a research project with EPRI in 2011. ATC hopes to gain an understanding of how, if any, real-time and predicted line ratings can increase the utilization of transmission assets while maintaining reliability and safety of the transmission system. The results of this project will compliment (enhance) EPRI's efforts in this area, specifically, program P35, Overhead Transmission.

Task 1: Collect data

An ATC transmission line has been instrumented with a standard instrument package, including ultrasonic anemometer, solar pyranometer (flux density meter), and air temperature sensor, in combination with two sagometers to gather field data. The first 3 months of data will be used to develop initial diurnal (day/night) cycles for wind (i.e. effective perpendicular wind speed) and load (if practical), with the 1%, 2%, 5%, and 50% levels explicitly identified on an hourly basis.

At the end of this initial data accumulation period, the data will be prepared into a file format readable by EPRI's Dynamic Thermal Current Rating (DTCR) software. The DTCR line data will be entered and checked at the same time.

Task 2: Sagometer Calibration

In order to use a sagometer for evaluating conductor temperature, it is necessary to develop the mathematical relationship between conductor temperature and measured sag. This is referred to as a sagometer "calibration" and will be monitored and refined over twelve months of data collection.

ATC chose to install the sagometers on a corner tower so that the impact of directional winds would be different for the two spans monitored.

Task 3: Investigate Weather Data Predictions

Accumulate weather predictions including temperature, solar intensity and, to the extent available, wind speed and direction.

Wind speeds are difficult to predict with the required accuracy needed for line rating calculations. This is particularly true for lower wind speeds that typically determine ratings. Prediction of wind speed on an hourly basis may be possible. Conventional predictions of wind speed and direction are unlikely to be useful in this particular application since such predictions are generally oriented toward maximum wind events in unsheltered areas. However, short term predictions of diurnal wind effects based on analysis of the wind data found in Task 1 can be made.

Other important variables for calculating ratings, such as air temperature and solar intensity, are reasonably predictable. Predicted air temperature and solar heat data, obtained from several convenient sources, will be compared for accuracy as a function of time. The goal is to identify the maximum predictive period for which line rating predictions can be made with high reliability.

Task 4: Determine and Compare the Predictability of Dynamic Line Ratings

Combining the most accurate predictive air temperature and solar heating data in Task 3 with the field data accumulated in Task 1, calculations will be made with DTCR to simulate the on-line calculation of dynamic line ratings. The accuracy of predicted line ratings will be compared for predictions that are 1 hour, 4 hours, 24 hours, 48 hours, and a week in advance.

The error of any given rating prediction will be measured two ways: the difference between the predicted and actual line rating in amperes, and the predicted and actual maximum line conductor temperature at full rated (as predicted) line current.

By doing this calculation many times, we can get an average error. These calculations will be made for the normal MOT and an emergency MOT.

Task 5: Data Analysis

Actual weather conditions and line sag, plus load and contingency data will be provided by ATC and analyzed for the duration of the study. The data analyses will be repeated at the 3, 6, and 12-month periods. Each analysis will build upon the preceding one. With this approach, the accuracy of the defined diurnal cycles will improve over the course of the twelve months.

Task 6: Diurnal Wind Cycles Explored Further

As a result of Tasks 1 – 4, diurnal cycles of effective perpendicular wind speeds for various periods will be developed. The correlation between higher wind speed and solar as well as the correlation between wind speed and air temperature will be explored in this task.

Reporting

ATC expects the final results in June 2013.